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A particle method for modeling seismic ground motion

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A particle-based continuum model for the simulation of seismic wave propagation is presented. Accurate simulation of seismic ground motion for arbitrary topography is a key issue for not only scientific interest but also disaster prediction and mitigation. In the present study, moving particle semi-implicit (MPS) method is applied to seismological simulation. MPS method has some advantages comparing to traditional continuous and discontinuous methods ; first, the introduction of traction-free boundary conditions is easier than finite difference methods (FDM), second, data structure in MPS method is simpler than that in finite element methods (FEM) because we do not need the connectivity between nodes and elements to discretize the analysis object, third, we do not need material parameter calibrations and can use arbitrary material constants unlike distinct element method (DEM) with a hexagonal arrangement. We first introduce moment-tensor earthquake source description to MPS method. Next, we demonstrate that a strong ground motion due to the surface basin structure can be reproduced by MPS method. Finally, we calculate surface wave propagation in the model with arbitrary surface topography. It is found that the method can reproduce the strong ground motion produced by earthquakes with satisfactory accuracy.

Keywords: particle method, seismic wave propagation, numerical simulation